Railroad Telecommunication Planning

Outputs

- Technical support to the Federal Railroad Administration (FRA) for all matters related to railroad telecommunications.

This project involves providing technical consulting on a continuing and as-needed basis to the Federal Railroad Administration (FRA), relative to any technical issues related to railroad telecommunications that may arise. For example, prior years' activities related to the Oregon Department of Transportation (ODOT) Pilot Project, which investigated the efficacy of utilizing TIA102-compliant radios in a railroad private land-mobile radio (PLMR) environment, and have been detailed in previous years' Technical Progress Reports, continued in FY 2003.

In FY 2003, a task that resulted from the FCC's Second Report and Order (R&O) 03-34 was undertaken by the Institute. The R&O is a matter with wide-reaching implications for the railroad industry. It concerns itself with, among other things, the mandatory migration of "wideband" (emission designator 16k0F3E) PLMR systems to "narrowband" (11k0F3E or 11k0F1E) systems. The railroad industry had raised concern that such a migration process will present significant challenges to implement.

The railroad PLMR infrastructure is comprised of more than 15,000 base stations, 45,000 mobile radios, and 125,000 portable radios nationwide. Each railroad manages its own PLMR infrastructure, and is responsible for ensuring that its base station assets provide the necessary RF coverage throughout its own territories, which are scattered nationwide.

It is common practice to find one railroad's locomotive operating in another railroad's territory, utilizing that "foreign" railroad's PLMR infrastructure. Furthermore, a locomotive could be expected to be found anywhere in the country at any given time — locomotives are not necessarily "captive" to a particular geographic area.

Hence, the dilemma in migrating to a nationwide radio infrastructure is this: with the sheer number of radios involved nationwide, owned and managed by different railroad companies, each railroad would be challenged to coordinate the simultaneous conversion of all its assets nationwide to narrowband technology all at once, and to coordinate such a massive undertaking with all the other railroad companies. Obviously, there will be a "transition" period where "mixed-mode" operation (wideband receivers operating with narrowband transmitters and vice versa) will be the norm. For example, a locomotive whose legacy radio had not yet been replaced, and that was operating in a territory whose base station had already been transitioned to narrowband technology, would be receiving a narrowband signal by its wideband receiver. Thus, the question arose as to the effects of such mixed-mode operations on the performance of land-mobile radios. It is this aspect of a migration that the railroads and the FRA wished to explore further.

Among other testing, the Institute subjected various commercial-grade radios of different manufacture to these mixed-mode operating conditions. The resultant data was provided to the FRA sponsor. The Association of American Railroads incorporated this work into comments that it filed last August in response to the aforementioned R&O.

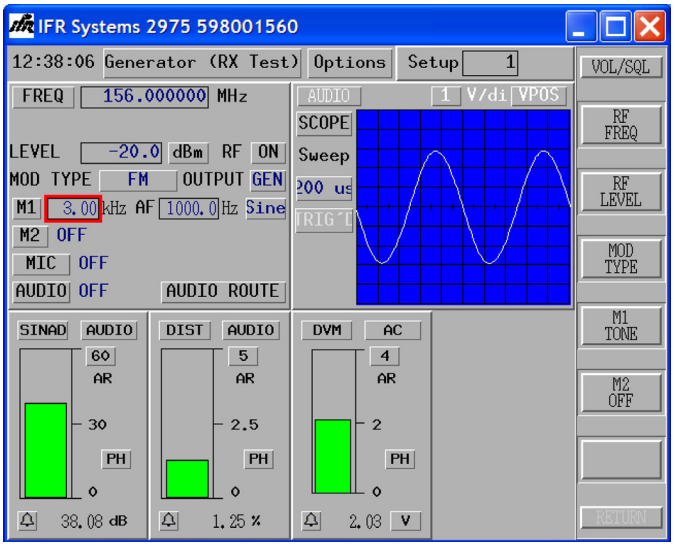

Figure 1. Wideband transmitter deviation with wideband receiver bandwidth.

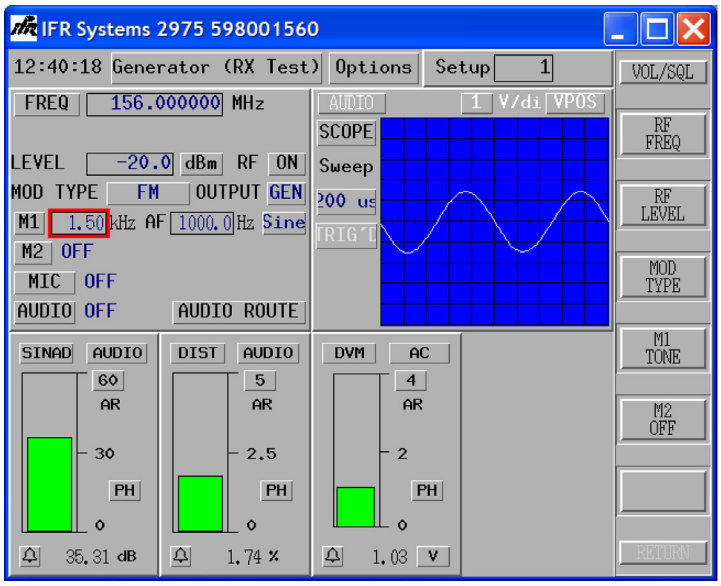

Figure 2. Narrowband transmitter deviation with wideband receiver bandwidth.

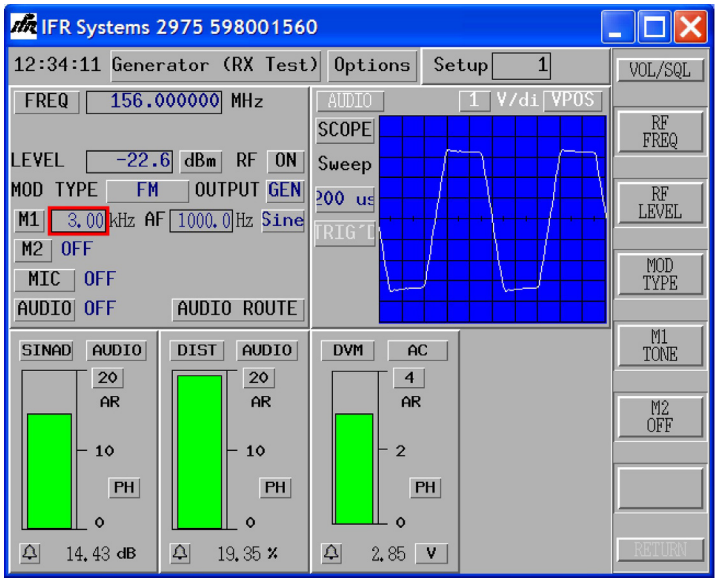

Figure 3. Wideband transmitter deviation with narrowband receiver bandwidth.

One important issue, revealed as an outcome of this work, is illustrated in Figures 1 through 3. Notice how the amplitude of the demodulated audio in Figure 1 (on previous page), the "legacy" configuration, is twice as large as the demodulated audio signal in Figure 2, an example of "narrowband transmitter/wideband receiver" mixed-mode operation.

Although an operator could simply turn up the radio's volume control to compensate for the decreased volume, the issue here is this: Suppose a locomotive roams out of a "legacy base station" region into a "narrowband base station" region. What if the engineer did not notice that at some specific milepost marker, he had entered the new base station coverage area and that therefore he had to increase the volume control setting on the locomotive radio? Is it possible, in the noisy acoustic environment of a locomotive cab, that the engineer might miss a critical radio transmission from the dispatcher?

Or consider the converse case, depicted in Figure 3, where a wideband transmitter signal is received by a narrowband receiver. It is quite clear from the figure that the demodulated audio is distorted. Could an engineer misunderstand a dispatcher's instructions because of such distortion?

It is issues such as these that the measurements revealed, and it is issues such as these that the railroad industry must now consider as it develops a wideband-to-narrowband migration strategy.

For more information, contact:
John M. Vanderau
(303) 497-3506
e-mail jvanderau@its.bldrdoc.gov